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COVER

Artist Larry Mauk of The Boeing Company depicts the Bicentennial Exposition on Science and Technology as it will look when work is completed at the 30-acre site at the Kennedy Space Center. Fifteen geodesic domes in the shadow of the Vehicle Assembly Building will house the Government-sponsored exposition, whose theme is humanity and the future. Sixteen Federal agencies and many private organizations are participating in the pageant, which will be opened to the public May 30. The space vehicle in the foreground is the flight hardware for an Apollo mission.

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Letter from Washington

Fletcher

Dear Colleagues:

The opening of the Bicentennial Exposition on Science and Technology at the Kennedy Space Center on the 30th of this month should be another day of achievement for NASA. The only Government-sponsored exposition during this Bicentennial year, it represents the imaginative and combined efforts of sixteen Federal agencies and many corporations from the private sector.

President Ford has referred to the exposition as an opportunity for millions of Americans to "see the best in America" not only from the past, but what is to come in the future. "It's a team effort," the President said, "that I think the American people will respect and thoroughly enjoy."

The idea of singling out science and technology for special emphasis as part of the nation's Bicentennial celebration is a good and timely one, and the Kennedy Space Center is the logical site. Our colleagues at KSC are eminently qualified to host such an exposition. Their record of accomplishment is one of which the rest of us in NASA, indeed all the American people, can be justly proud.

The ideal of freedom, especially in the realm of new concepts, made America the birthplace of a scientific and technological renaissance that has led and enlightened mankind for the past two centuries. From Ben Franklin and Thomas Jefferson to Thomas Edison and Robert Goddard and on to the astronauts of the 1960s and 70s, America's inventors, innovators and pioneers have built for us and future generations a priceless legacy.

This exposition will be an opportunity for all Americans to review our successes and reflect on our future while at the same time providing a psychological lift to those who practice in the broad spectrum of scientific and technological disciplines—the researcher, the scientist, the technician, the astronomer, the agronomist, the oceanographer and others.

Housed in 15 geodesic domes adjacent to the KSC Vehicle Assembly Building, the exposition will emphasize people and the future. The sixteen Government agencies involved represent a broad cross section of our society. Their exhibits will illustrate the present role of science and technology in health, education, industry, finance, media, and government affairs now, and in a limited way these same—and some unexplored—disciplines projected over the next one hundred years.

Advances expected in numerous technologies such as housing, agriculture, communications, aeronautics and space will be featured.

Although it will last for only a little more than three months, the exposition is an opportunity to emphasize a continuing national commitment to scientific and technological progress for all mankind during the next century thus keeping alive the spirit of 1776.

Sincerely,

James C. Fletcher

Monthly NASA Highlights

Bright New Comet Is Studied

Comet West, one of the most spectacular celestial objects seen in many years, was visible during the first half of March near the eastern horizon. Many thousands of people who arose an hour or so before sunrise could clearly see the comet, without the aid of telescopes or other instruments, as it streaked through the sky 120 million kilometers (75 million miles) from Earth. One of the brightest comets ever—five times as luminous as scientists had predicted—it was only the fourth one in the 20th century that was visible to the unaided eye, even in daylight.

NASA, in company with numerous astronomy experts in this country and abroad, conducted an extensive program of space- and ground-based observation of the great comet, studying it from Earth and in space, using telescopes, cameras, sounding rockets and airborne observatories.

Comet West, discovered by Richard M. West of the European Southern Observatory (Geneva, Switzerland) in November 1975, reached its perihelion (closest point to the Sun) on Feb. 25, passing within 30 million km. (18.6 million mi.). As a comet nears the Sun, scientists explain, its surface heats, the ice within its nucleus vaporizes, and the resulting molecules are broken up by solar radiation into more complex molecular material that forms the "tail" of the comet. Sunlight shining on Comet West's very long tail—stretching 30 degrees from tip of the tail to the head of the comet—made the comet highly visible to Earth inhabitants.

Comet West provided scientists with the first opportunity for extensive cometary study since Comet Kohoutek appeared in 1973. Taking advantage of the opportunity were, among others: the Goddard Space Flight Center's Astrochemistry Branch in conjunction with the New Mexico Joint Observatory of Cometary Research; the Ames Research Center, which sent an airborne observatory aloft, as well as support aircraft; the University of Colorado, using a spectrometer to study the ultraviolet spectrum of the comet; and the U.S. Naval Research Laboratory, which used a spectrometer and an electrographic camera to record images.

Observations were curtailed in mid-April as the comet receded from the Sun and the Earth. Sightings without the help of instruments were barely possible at the beginning of April when the comet was 169 million km. (105 million mi.) from Earth, and by April 15, when the distance had increased to about 180 million km. (112 million mi.), observation was possible only by telescope.

Scientists are now studying the large quantities of data obtained from the investigation. One of the features of special interest to the researchers is the high brightness of the comet even after perihelion, which apparently was caused by the splitting of the nucleus, perhaps into as many as four parts. Observers point out that such an event probably has no drastic effect on the main body of the comet—only that little fragments split off, which caused the longer-than-usual visibility.

Comet West will not be seen again by Earthlings for at least 15,000 years.

Brilliant Comet Blazes through Clear Skies—The incandescent Comet West was clearly visible in the eastern sky just before dawn during March. The comet showed a dust tail with an unusual amount of structure, causing the comet to remain distinct for an unusually long period. NASA scientists participated in worldwide observation of Comet West as it traveled past the Sun. By late March, the comet was 153 million miles from Earth. Photo was taken by S. Larson at Mount Lemon near Tucson, Ariz., March 9, 1976.

Second RCA-Satcom Successfully Launched

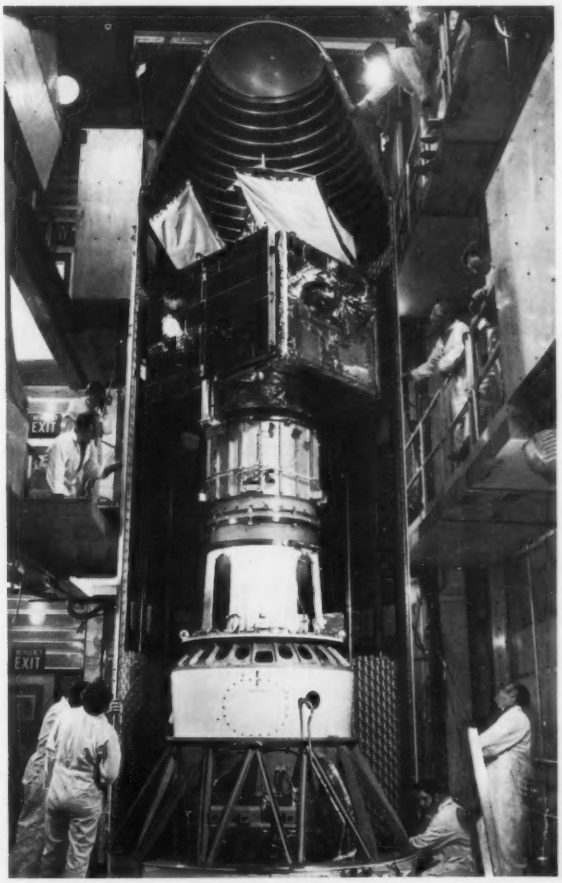
The RCA-2, the second in a series of large 24-transponder domestic communications satellites, was successfully launched by the Kennedy Space Center on March 26, 1976. The launch vehicle for the mission was the second Delta 3914 configuration, which is a power-augmented version of the standard 2914 Delta vehicle using nine larger Thiokol Castor IV solid-propellant strap-on motors. The first launch of the Delta 3914 placed the RCA-1 spacecraft into orbit in December 1975.

Launch support for the mission was provided by NASA on a fully reimbursable basis to RCA-Globcom, a subsidiary of the Radio Corporation of America.

The RCA-Satcom system will consist of two satellites placed in synchronous orbit to serve the contiguous United States and Alaska with television, voice channels and high-speed data transmission.

The Goddard Space Flight Center manages the Delta program for NASA's Office of Space Flight and also has responsibility for the tracking network. Launch operations are managed by KSC's Unmanned Launch Operations.

Communications Satellite Readied for Launch—The RCA Satcom 2 during prelaunch testing. The domestic communications satellite was launched March 26.

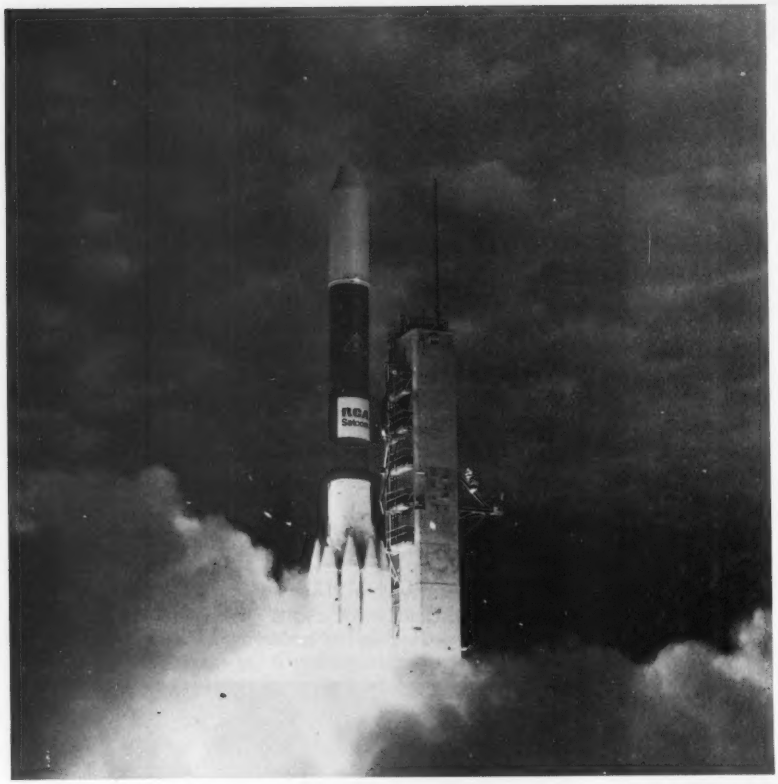


Research on Gaseous Fuel Reactors

A new type of nuclear reactor that contains its fissionable fuel in the gaseous phase is under investigation at the Los Alamos Scientific Laboratory, under a NASA-sponsored research program. Because gaseous fuel reactors have the potential of operating at temperatures at which solid fuel rods would melt, they are more efficient than conventional reactors. In addition, the gaseous phase of the fuel provides advantages of continuous reprocessing of the fuel and improved fuel utilization. In space power applications, these translate into economy and reduced specific mass.

Furthermore, recent success in nuclear-pumped laser research, also conducted under NASA programs, indicates that part of the power from a gaseous fuel reactor could be generated directly in the form of laser beams, which could lead to a new generation of space technology. Energy from a nuclear power station in space could be transmitted over great distances to users on space platforms, to lunar bases, or to space-ships for propulsion.

The present reactor experiments involve hardware salvaged from an earlier NASA/AEC nuclear rocket program. Principal component is a beryllium moderator-reflector assembly with associated control mechanisms, providing for a cylindrical cavity of approximately one cubic meter volume. This cavity was first loaded with uranium foils, simulating a filling of enriched hexafluoride gas. In this fashion, the basic reactor physics were established. Reactor tests are now underway with a



A Recent NASA Launch—The second RCA-Satcom spacecraft at the moment of launch from the Kennedy Space Center in late March. The RCA-Satcom system consists of two satellites placed in geostationary orbits to serve the contiguous United States and Alaska with television, voice channels and high-speed data transmissions. RCA Global Communications, Inc., as trustee for RCA American Communications, Inc., has direct management responsibility for the system.

partial loading of gaseous uranium hexafluoride. An appreciable part of the reactivity remains in solid fuel driver rods taken from the nuclear rocket program to simplify research on the characteristics and behavior of the fissioning gases. The next steps will be to test the experimental reactor with a through-flow of the gaseous fuel and its fluid mechanical confinement, for high temperature and high power operation.

Several benefits for the terrestrial use of technology on gaseous fuel reactors can be added to those related to space application, including: breeding nuclear fuel from thorium; inherent safety features, such as the elimination of loss-of-cooling and melt-down problems encountered in solid-fuel reactors; and the ability of the reactors to burn up waste products by means of fission and nuclear transmutation.

The work at Los Alamos is supplemented by theoretical and experimental research under NASA grants by five universities and an industrial laboratory.

New NASA Book Published

A three-volume report entitled "The Outlook for Space," was recently published by NASA. The report, the result of a year-long study conducted by top NASA engineers and scientists, identifies possible space activities for the United States over the next 25 years.

Included as projects most worthy of consideration are large space stations or laboratories in Earth orbit, a Moon colony and industrial facilities, and the beginning of permanent Earth-orbiting space colonies and industrial facilities. The study group suggests that, for the remainder of this century the agency should place emphasis on Earth-oriented activities responsive to basic human needs; it also recommends that a continuing, well-planned investigation of the solar system be carried out during the last quarter of this century, extending into the 21st century.

The publication, which took a year to complete, was produced at NASA's Goddard Space Flight Center by a 20-member group headed by Donald P. Hearth, at the time deputy center director. He is presently director of NASA's Langley Research Center.

Inasmuch as the study touched upon virtually all scientific and technical disciplines, the study group received guidance from the widest possible variety of competent sources. Personnel of the Jet Propulsion Laboratory prepared the forecast of space technology included in the report; top professional organizations, such as the Space Science Board of the National Academy of Engineering, provided advice and recommendations; the Smithsonian Institution arranged a seminar in which contributions were made by scientists and technicians throughout the country.

The 60-page "Outlook for Space" synopsis volume lists space projects NASA should consider for the final quarter of this century under 12 major objectives. Detailed text of the full three-volume report is contained in the two main volumes "Outlook for Space—Report to the Administrator" (SP-386, 400 pages $4.40); and "A Forecast of Space Technology—1980-2000" (SP-387, 300 pages $4.00). Both are available from the Superintendent of Documents, Washington, D.C. 20401.

Viking Flight Team in Realistic Training Program

The 750 members of the Viking Flight Team recently experienced a test and training exercise so realistic that a casual observer would have had difficulty in distinguishing it from the real mission. The mission period selected for the exercise at the Jet Propulsion Laboratory consisted of two days before lander separation through SOL 8 of landed operation. (A SOL is a Mars day of 24.6 Earth hours.)

All the simulated spracecraft data were programmed into one of the large computers by the mission planners before the exercise began. The data then were relayed to the Mission Control and Computing Center through a Deep Space Net data line on the same schedule that would apply to such data during the real mission. Data were then decoded and individual data packages delivered to the appropriate science and engineering teams for analysis, interpretation and necessary action. None of the teams knew in advance the content of the data packages they received.

The period of time allowed for data reduction and decision-making was set to match an actual mission schedule. Decision-making procedures involved the formulation of "uplink commands" to change experiment sequences and instrument settings as the need arose. Realism was additionally simulated by holding press conferences and interviews during which the teams were asked about the data, their interpretation of various factors, and the implications of findings. A light moment occurred when the imaging team spotted some trilobites (marine fossils) half-buried in the sand within the camera's field of view of the imitation Martian surface. Resolution of the picture permitted instant recognition of the small objects, followed by the quick realization that pranksters were responsible for their presence.

At mission's end, the flight team had clearly demonstrated its ability to carry out the necessary functions and an ability to adapt to various situations and changes. Some problems were uncovered that required adjustment of computer timelines for data processing and ground control procedures, and to facilitate commands to the spacecraft, but no major difficulties were encountered. The unqualified success of the test will make it possible to decrease other test and training exercises. ■■■■■

Avant Garde Space Uniforms

The latest thing in space suits and rescue systems for use by Space Shuttle travelers is being developed at NASA's Johnson Space Center for use when the Shuttle becomes operational in 1980.

Engineers at JSC have designed a Shuttle suit that features an "adjustable fit" concept, a departure from the garments used in earlier manned space programs, each of which was custom-designed for each astronaut in a long and costly process. The new design consists of a two-piece combination for upper and lower torso, the suits to be manufactured in small, medium and large sizes, adjustable to accommodate all astronaut candidates and crew members, including females. The suit has a body-seal closure at the waist, which eliminates the need for the pressure-sealed zippers used in Apollo and Skylab suits.

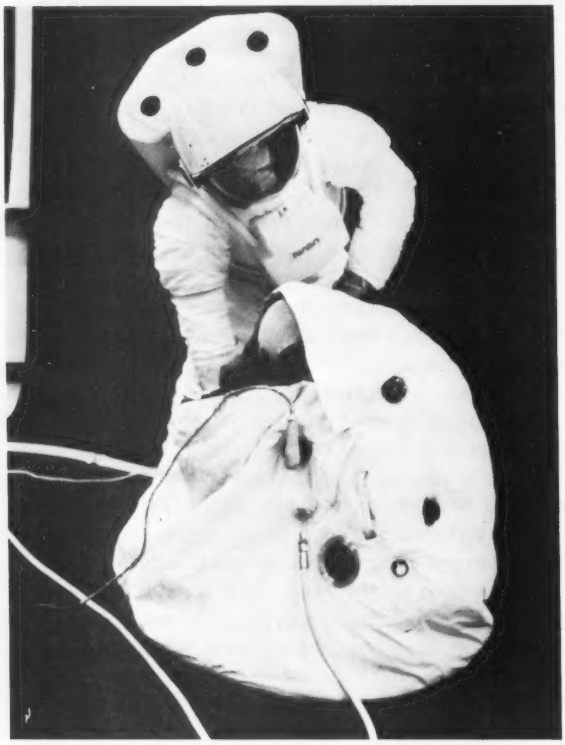
The Shuttle pilot and mission specialist will each be outfitted with the space suit. The commander and payload specialists will be provided with another innovation, called the "Personal Rescue Enclosure." Should one of the Shuttle Orbiters become disabled, necessitating the removal of passengers from the marooned craft to a rescue platform, this enclosure will be brought into play. The system consists of an 85-centimeter (34-inch) ball containing its own short-term simplified life support and communication systems. The contraption, conceived and fabricated by members of the Crew Systems Division at JSC, is made in three layers of heavy but malleable fabric—Urethane, Kevlar and an outside thermal protective layer—and a small viewing port of tough Lexan.

Three modes for the transfer of persons from one vehicle to another are now under study. One is for a space-suited astronaut to carry the rescue balls, as one would carry a suitcase, from vehicle to vehicle; a second is to hook up a line between two spacecraft and pass the rescue ball—containing a passenger—in clothesline fashion from damaged craft to rescue vehicle; a third method might involve the use of a remote manipulator arm in the cargo bay of the Orbiter, which could pluck the rescue ball with passenger from one ship to the other.

The materials used in the newly designed suit and rescue ball are much more durable and versatile than those used in earlier styles. For instance, the strong Kevlar fabric makes possible the formation of joints (at elbow, wrist, knee or other) from the flat fabric instead of from molded rubber convolutes enclosing cables. Not only are the new fabric joints more mobile, they reduce the cost and weight of each suit.

Still another advantage of the Shuttle suit is its built-in life-support system. When Apollo astronauts walked on the Moon, for example, they first had to remove a bulky 75-pound life support system from storage, then connect it to their space suits. The new version is designed to carry a portable system as an integral part of the rigid upper torso.

As the Space Shuttle reaches its planned capability of some 60 missions annually, the needs of the next generation of humans in space for these and other inventions of the most advanced and efficient nature will steadily become greater.



New Attire and Gear for Space People—A newly developed space suit and a rescue device for use aboard the Space Shuttle in the 1980s are demonstrated at the Johnson Space Center. New, lighter and stronger material is used in both. The Shuttle suit carries its own built-in life-support system. The rescue ball, called the personal rescue enclosure, is designed to carry an endangered space traveler from one vehicle to another. It has its own short-term life support and communication system. In this photograph, a man is inside the rescue ball; he can look outside through a small viewing port.

Did You Know?

A test program aimed at finding ways to minimize noise generated by vehicle engines during a Space Shuttle launch is underway at the Marshall Space Flight Center. The effort is important to the program because sound energy can affect sensitive instruments or other payloads carried in the Shuttle Orbiter. A number of test configurations that spray water into, above and below the rocket exhaust have achieved significant reductions in noise.

Scientific experiments for the first Spacelab mission, planned for late 1980, are being sought by NASA. Dr. Noel W. Hinners, Associate Administrator for Space Science, briefed interested parties at a March 22 meeting concerning the objectives set for Spacelab. Primary among them is verification of the performance of Spacelab systems and subsystems, and the measurement of the environment surrounding the Shuttle. Secondary is the need to obtain valuable scientific, applications and technology data and to demonstrate the broad capability of Spacelab to perform space research. Stratospheric and upper atmosphere research will be emphasized on the first flight, but proposals from other scientific disciplines also will be solicited. The request for proposals is to satisfy the secondary objective.

TWA Services, Inc., was awarded a $1,848,265 contract by the Kennedy Space Center to manage the center's construction program for the housing of the Bicentennial Exposition on Science and Technology. The cost-plus-fixed-fee contract also provides for possible additional construction commitments of $148,735 and other options if required, totaling $495,000. KSC is host to the exposition, to function May 30 through Labor Day.

Five engineers employed at NASA's Marshall Space Flight Center were given special awards recently by Alabama-based engineering organizations: Dr. Nicholas Costee was named Outstanding Aerospace Engineer, Ann Mitchell was designated Value Engineer of the Year, Robert L. Middleton was named Outstanding Engineer, Harold K. McCaleb received the Outstanding Engineer Award and Jimmy L. Miller was given the Outstanding Service Award.

When the Space Shuttle Orbiter main engines and two Solid Rocket Boosters are fired simultaneously at launch, they will produce a sea-level thrust of 28,134,865 Newtons, or 6,325,000 pounds, at liftoff.

Minority opportunities in the aerospace program was the theme of three one-day symposiums held at Howard University in Washington, D.C. last month in cooperation with NASA. The event featured workshops and exhibits to encourage minority students to contemplate careers with NASA and the space industry.

High-school students from five sections of metropolitan D.C., and students from 10 minority-oriented colleges and universities in the eastern region attended. Faculty members participated as well.

The Bionetics Corporation of Hampton, Va., has been chosen by NASA's Kennedy Space Center for negotiations leading to a contract to provide standards and calibration support services over three years. The standards and calibration support contract, a small-business set-aside, is for services now provided under the center's contract with the Federal Electric Corp., for launch communications and instrumentation. The amount of the contract will be more than $500,000 annually. ■ ■

Pioneer 10 Supplies New Information about Jupiter

Pioneer 10 sensors indicate that the planet Jupiter has an enormous magnetic tail almost half a billion miles long, completely spanning the distance between the orbits of Jupiter and Saturn. Magnetic tails are the magnetic envelopes around the planets, stretched out by the force of the million-mile-an-hour solar wind that "blows" constantly outward from the Sun.

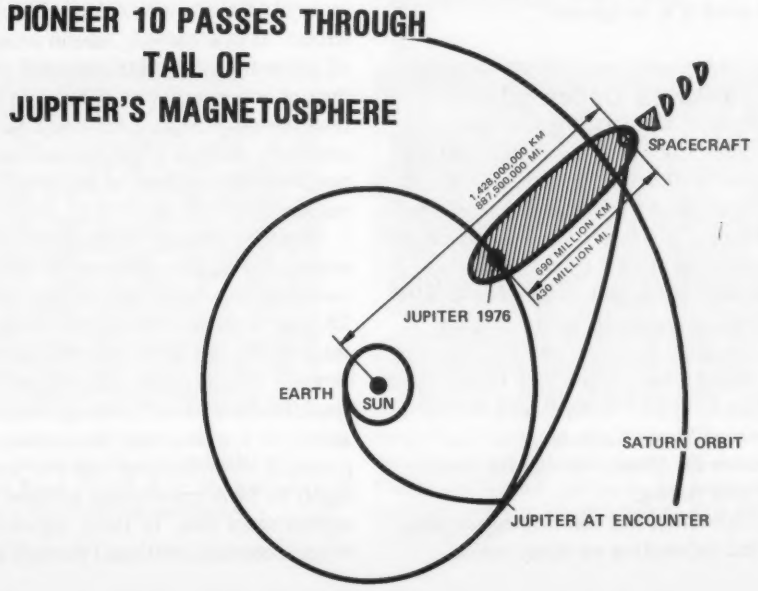
Data collected by Pioneer instruments show that Pioneer 10 crossed Saturn's orbit in early February; in mid-March Pioneer was solidly in Jupiter's tail for at least 24 hours.

Project scientist Dr. John Wolfe of NASA's Ames Research Center, in a discussion of the apparent encounter with the tail, said that no evidence of a solar wind was seen in the data returned from Pioneer during this period. That lack could be attributed to a shutting out of the solar wind by the planet's tail structure.

Wolfe said it was "barely conceivable" that the solar wind could have died completely for the one whole day when no wind data whatsoever was recorded, but that he believes the findings indicate that Jupiter has a "very stretched-out magnetic envelope or tail," stretching all the way from Jupiter to Saturn.

The discovery suggests to program scientists that Saturn itself should enter Jupiter's tail once every 20 years. If so, the next such event should happen in April 1981. The find also means that Pioneer 10 has again come under the influence of Jupiter almost two-and-a-half years after its swing around the giant planet.

"Jupiter, which has three-quarters of all the planetary material in the solar system, is so huge that such a long tail is understandable," Wolfe said, adding that Jupiter and the Earth are the only two planets known to have strong magnetic fields created by the flow of liquid metal in their interiors. The magnetic tails of both planets are believed to be shaped like the tails of comets, and like comet tails, result from solar processes.



California Business Delivers Test Component—E. T. Warner (right), Cherokee Indian president of the Aircraft Engineering Corp., with Charles Grady of Rockwell International Space Division, after delivery of the Main Propulsion Test Article truss assembly, part of which is in background.

Space Shuttle Hardware Delivered

The Aircraft Engineering Corporation, a minority-owned firm at Paramount, Calif., has completed delivery to the Rockwell International Space Division of a major piece of equipment for testing of the Space Shuttle. The $900,000-plus contract for the fabrication of a mammoth welded structure—called the Main Propulsion Test Article truss assembly—is the largest awarded to a minority sub-contractor by Rockwell on the Shuttle Orbiter project.

The heavy assembly—23 meters long, 5½ m. high, 5 m. wide (72 feet, by 18 ft. by 17 ft.) eventually will be used at NASA's National Space Technology Laboratories, to simulate the Shuttle Orbiter for main engine and external tank testing.

The 17-year-old corporation has contributed services in both engineering and fabrication on many major programs throughout the United States, ranging from missile assemblies and submarine periscope masts, to body shells for rapid transit vehicles. The president of Aircraft Engineering Corp. is E. T. Warner, a Cherokee Indian.

A Time to Remember

May 1976 Marks the 15th Anniversary of the First Venture into Space by an American Astronaut

"Call back yesterday, bid time return," words written by William Shakespeare 400 years ago, are bound to strike a responsive note in many of the thousands of people who have demonstrated a deep commitment to the U.S. space program during past years. In this context, "yesterday" is less than 20 years ago—1958, to be exact, when NASA was born—and only 15 years ago in terms of a round trip into space from Earth by an American. (Russia's Yuri Gagarin was sent into space a month earlier.)

It was on May 5, 1961 that Alan B. Shepard, Jr., became the first NASA astronaut to blast off from Cape Canaveral in a Mercury spacecraft called "Freedom 7." That 15-minute suborbital flight, which ended in triumph when a U.S. Marine Corps helicopter team fished the astronaut out of the sea less than 20 minutes after liftoff, introduced one of the most exciting and inspirational chapters in this country's history.

Dreams became a national goal three weeks afterward when then-President Kennedy announced the decision to land a man on the Moon within the decade and return him safely to Earth.

As NASA's former Administrator, James E. Webb, wrote: "It [the ensuing Apollo program] was a new kind of national venture. Suddenly and dramatically it brought men of action and men of thought into intimate working relationships designed to solve a large number of extremely difficult scientific and technical problems. It was a major challenge to legislators, scientists and engineers."

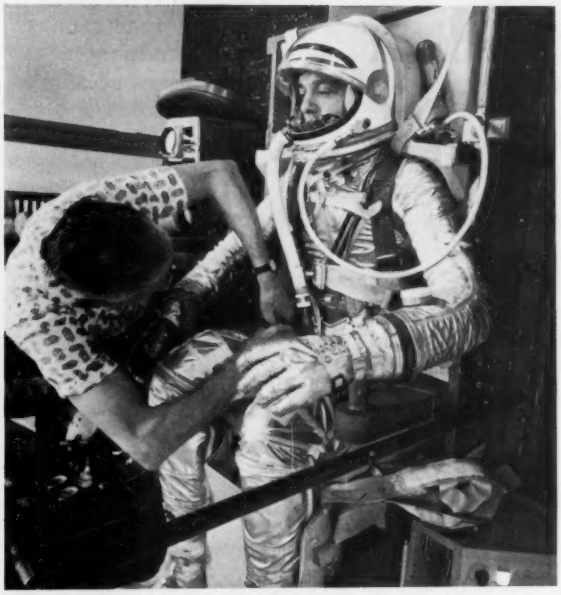
Was the challenge met? Indeed it was—and then some—during the following 12 years: A Mercury vehicle carried the first man into orbit in 1962, followed by a 22-orbit flight in 1963. The first maneuvering system was used during three orbits aboard the first manned Gemini flight in 1965, followed by a 62-orbit journey in space by Gemini 4. The longer-lasting Gemini 5 answered a wide range of questions concerning a potential Moon landing, and two more manned Gemini flights in 1965 contributed additional and ever more sophisticated data. In 1966, trial-and-error experimentation continued through four manned Gemini

flights, which culminated in two demonstrations of how life support systems would work on the Moon.

World suspense heightened during the next two years as Apollo flights were repeatedly made and numerous tests completed, all directed toward attainment of the stated goal. Results ranged from flawless successes to high tragedy.

The great moment came in 1969, on the morning of July 20, when Neil Armstrong spoke the unforgettable words from the Moon's surface: "The Eagle has landed!" He and his companions, Michael Collins and Edwin Aldrin, spent the next four days of the Apollo 11 mission on lunar explorations and returned to Earth July 24, to be welcomed with wild enthusiasm throughout the world.

Administrator James C. Fletcher alluded to some of NASA's past glories not long ago when he said: "Less than two decades ago, we were proudly pointing to a grapefruit-sized satellite in orbit. Today we are sending robot spacecraft to explore the surface of other worlds . . . We must keep the dreams of space alive, for in the long run they will prove of far more importance than the attainment of immediate material benefits."



Astronaut Shepard before the Big Event—Alan B. Shepard, Jr., has his pressure suit adjusted in preparation for his historic launch into space aboard a Project Mercury spacecraft atop the Mercury-Redstone booster.

Up and Away—The first man in space was launched into suborbital flight on the Mercury Redstone 3 from Cape Canaveral launch site on May 5, 1961.

Presidential Recognition—After his first flight into space, astronaut Shepard receives congratulations from President Kennedy on the lawn at the White House. Shepard's wife and mother stand at left of picture; six astronauts and NASA officials are in background.

Ticker Tape Parade for Space Heroes—New York City welcomes NASA astronauts Neil A. Armstrong, Michael Collins and Edwin E. Aldrin, Jr., in a parade down Broadway, called the largest in the city's history, after the first Moon landing in 1969.

Lewis Director Lundin Receives Award

The National Space Club's prestigious Astronautics Engineer Award recently was presented to Dr. Bruce T. Lundin for outstanding leadership in the development and operation of the Centaur high-energy rocket stage and the Atlas/Centaur and Titan/Centaur launch vehicles. Lundin was appointed director of NASA's Lewis Research Center in 1969, after 26 years of service with the space agency and its predecessor, NACA.

Lundin has spent almost all the years since 1943 at the Lewis center; most of his efforts during the 1960s were concentrated on perfecting Centaur. He helped set the policies, made the critical decisions, built the NASA-Lewis staff, established good relations with contractors and, by example, set the character and style of the entire project. His work won him NASA's highest award, the Distinguished Service Medal, in 1971.

The Atlas/Centaur vehicle successfully launched all the Surveyor spacecraft in the 1960s, as well as many other large and prominent spacecraft, including the OAOs, Intelsats, Mariners and Pioneers. Centaur recently was mated with the Titan booster to form the Titan/Centaur launch vehicle, currently the nation's largest rocket.

Stations in Space to Be Versatile Work Centers

Work began April 1 on parallel studies of systems to be employed by space stations under fixed-price NASA contracts with the Grumman Aerospace Corp. (Bethpage, N.Y.) and the McDonnell Douglas Astronautics Co. (Huntington Beach, Calif.). Each study, based on the concept of an operational base in space which also can be used as a space laboratory, will be carried out in 18 months and each will cost about $700,000.

The Grumman study is managed by the Marshall Space Flight Center, the McDonnell Douglas study by the Johnson Space Center. The contractors will define and analyze concepts of space station facilities for low and synchronous altitude Earth orbit, including orbit-to-orbit transportation. Of great importance is the creation of a space station of modular construction with the ability to grow and expand over many years.

The station is envisioned as a test and construction facility with a capability of supporting the manufacturing, fabrication and assembly of large space structures necessary to gain benefits from space for use on Earth; as a base for the retrieval and repair of spacecraft; and as a refueling center for space vehicles.

As a space laboratory, the station should be capable of accommodating processing systems for various materials, research and development leading to commercial manufacture of products, experiments in basic and applied sciences, space physics and astronomy missions, and life science research. Such a laboratory also would be used for the continued development of sensor technology in subjects such as Earth surveys, navigation, weather and climatology.

Two NASA Men Win Top Awards

Recipients of the 1976 Arthur S. Flemming Award are Joseph R. Chambers of the Langley Research Center and Arnold D. Aldrich of the Johnson Space Center.

NASA Employees Achievements Recognized—Arnold D. Aldrich of the Johnson Space Center and Joseph B. Chambers of the Langley Research Center, two of ten 1975 recipients of the yearly Arthur S. Flemming Award, hold plaques received at a special luncheon held in Washington, D.C. Pictured left to right are E. S. Groo, Associate Administrator for Center Operations; Chambers; Arthur S. Flemming; Aldrich; Joyce M. Gray of NASA's Office of Personnel; and Charles H. King, Jr., Office of Space Flight.

The awards were presented at a mid-March luncheon ceremony held at the Mayflower Hotel, Washington, D.C. Sponsored by the Downtown Jaycees of Washington, D.C. for the 28th year, the award is given in recognition of achievements of young men and women in Federal service.

Chambers, in charge of the Dynamic Stability Branch at Langley, was cited "for outstanding achievement in reducing the hazards from aircraft stalling and spinning and for increasing combat maneuverability of fighter aircraft." Aldrich, manager of the Space Shuttle Program Office at JSC, received his award "for distinguished service to the nation's manned space flight programs in the Apollo, Skylab, and Apollo/Soyuz Test Project missions."

The awards are named in honor of Arthur S. Flemming, presently serving as U.S. Commissioner on the Aging and as Chairman of the U.S. Commission on Civil Rights, who has seen almost four decades of distinguished Federal service. He was Secretary of Health, Education and Welfare from 1958 to 1961.

New Life Force under the Sun

NASA scientists have played an important part in chemical and biological studies that resulted in the discovery of a previously unknown source of photosynthesis (the conversion of sunlight into other forms of energy), in the purple pigmentation of organisms found in extremely salty waters. Heretofore, long-accepted scientific theory held that green chlorophyll alone was the basic building block of life on Earth because of its ability to transform sunlight into plant life.

The important new facts were described at a recent news conference held by scientists from the University of California's Medical Center in San Francisco, and from NASA's Ames Research Center. The NASA contribution came through its program of studies of Earth life forms able to withstand extreme environments such as might be found on other planets. Dr. Walter Stoeckenius, professor of cell biology at the university, and co-workers there and at Cornell University are credited with the discovery. Certain phases of the investigation were carried out by Ames' Drs. Harold P. Klein and Janos Lanyi.

Dr. Stoeckenius said his study of the salt-flat bacteria involved in his experiments began 10 years ago at Rockefeller University, N.Y. He wanted to find out how their cell membrane could tolerate an environment of nearly 100 percent saltwater. Research disclosed that a purple pigment covering the outer membrane of the bacteria (scientific name, *Halobacterium halobium*) ejects hydrogen ions (protons) when exposed to sunlight. The light creates a slight electrical current from inside the cell to outside.

"Sunlight is thus converted into electrical energy," Stoeckenius said. The purple pigment, he added, seems to have a close chemical similarity to a pigment found in the eyes of many animals, including humans, which improves night vision.

Though the research so far performed is still in preliminary stages, scientists are calling the discovery "important and exciting." They say that practical applications stemming from the new photosynthetic mechanism at some future time may include: conversion of light directly to electricity through the manufacture of solar cells from the purple-pigmented material—such cells are presently being made on a small and experimental basis; a system to desalinate seawater; and new methodology to explain cell structures and processes to various branches of medicine.

Ames Scientist Is Honored

Dr. James B. Pollack, a research scientist stationed at the Ames Research Center, was given the center's 1975 H. Julian Allen Award in mid-March for the scientific paper "Aircraft Observations of Venus' Near-Infrared Reflection Spectrum: Implications for Cloud Composition."

The award carries with it an honorarium of $1,000, which senior author Pollack shared with co-authors Edwin Erickson, Fred Witteborn, Charles Chackerian, Jr., Audrey Summers, Warren Van Camp, Betty Baldwin, Gordon Augason and Lawrence Caroff, all of Ames. Established in 1969, the award is given in recognition of outstanding scientific and engineering papers produced by Ames personnel.

The paper describes observations made by Pollack and co-workers in 1974, which revealed that a major part of the clouds of Venus are made of a water solution of concentrated sulfuric acid. According to their findings, at least the top 20 kilometers (12 miles) of the planet's heavy cloud cover consist of the acid, in the region between 50 and 70 km. (30 and 42 mi.) above the Venusian surface. Additional significance is attached to the fact that sulfuric acid, being an efficient heat absorbent, could account for the extreme heat near the surface of the planet.

Pollack is co-investigator on two Pioneer-Venus experiments, and also a co-investigator for an experiment on the 1976 Viking lander to study Mars' atmosphere. He was with the Smithsonian Astrophysical Observatory at Cambridge, Mass., and later with Cornell University, before joining Ames. He won his B.A. degree at Princeton, his M.A. at the University of California at Berkeley, and his Ph.D. in astronomy at Harvard.

Aircraft Crew Chosen for Shuttle Carrier Aircraft

NASA recently announced the names of the initial crew of the 747 Shuttle carrier aircraft that will carry and launch the Space Shuttle Orbiter for its approach and landing tests. They are: Fitzhugh L. Fulton, Jr., and Thomas C. McMurtry, pilots; Victor W. Horton and Louis E. Guidry, Jr., flight test engineers. The first three are from the Dryden Flight Research Center and Guidry is from the Johnson Space Center. All are civilians.

Fulton is a veteran multi-engine test pilot with wide experience as a launch pilot. He was launch pilot for the X-15 and for manned lifting bodies, as well as on other experimental aircraft flight test programs. He was an XB-70 project pilot for NASA and the USAF. Currently Fulton is co-project pilot on the triple-sonic YF-12 flight research program.

Pilots for Shuttle Carrier Aircraft—Thomas C. McMurtry (left) and Fitzhugh L. Fulton, Jr., civilian research pilots stationed at the NASA Dryden Flight Research Center, will pilot the modified Boeing 747 aircraft that will carry the Space Shuttle Orbiter on test flights in 1977.

McMurtry has been flying experimental aircraft for NASA since 1967. As project pilot on the Supercritical Wing, he made the first flight with the new airfoil shape. He has flown as co-project pilot on the Digital Fly-by-Wire aircraft and the Supercritical Wing F-111, and as co-project pilot on NASA's 990 and C-141 multi-engine aircraft.

Horton is flight test engineer on the YF-12 at Dryden and has flown as launch-panel operator of the B-52 air-launch aircraft. At the Johnson Space Center, Guidry has flown as test engineer on the C-135 Zero-G studies and the C-130 Earth Resources aircraft.

Backups Joe Algranti and A. J. Roy, Jr., both of JSC, will pilot the 747 on flights to be scheduled after the initial test period. The 747 aircraft that will be used to carry the Orbiter aloft and release it to glide to Earth in tests scheduled for 1977 will undergo required modifications at the Boeing Company.

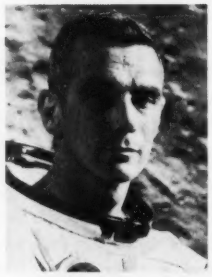
Test Pilots Named for Space Shuttle

Four men have been selected by NASA to become the members of two teams assigned to the initial flight testing of the Shuttle program, called the Space Shuttle Approach and Landing Test. The ALT tests will begin in mid-1977 at NASA's Dryden Flight Research Center.

Selected for the first team were: Commander Fred W. Haise, Jr. and pilot Charles G. Fullerton; for the second team Commander Joe H. Engle and pilot Richard H. Truly. Part of their training will take place aboard a NASA T-38 aircraft with special speed brake and on a Shuttle training plane (a twin jet Gulfstream II with modifications), as well as in a Shuttle procedures simulator and an Orbiter aeroflight simulator. During the actual ALT tests, a modified 747 aircraft will carry the Orbiter in piggyback fashion to an altitude of 7,500 meters (25,000 feet), where it will be released and its crew of two occupants will pilot the Orbiter—gliding without power—to the ground.

Haise, a member of the NASA astronaut program since 1966, was backup lunar module pilot for Apollo 8 and 11, lunar module pilot on Apollo 13, and backup commander on Apollo 16. He is the only one of the four who has flown in space. Lt. Col. (USAF) Fullerton has been with the astronaut program since 1969, and served on the support crews for Apollo 14 and 17. Col. (USAF) Engel has been with the astronaut program since 1966, was a member of the astronaut support crew for Apollo 10, and was the backup lunar module pilot for Apollo 14. Cdr. Truly (USN) joined the astronaut program in 1969, and was part of the support crew for all three manned Skylab missions.

Veteran Spaceman Leaves Government Service



Cernan

Astronaut Eugene A. Cernan, the last man on the Moon, plans to retire from the Navy and leave NASA July 1. Cernan, a captain, completes 30 years in the Navy in June. His future plans are not known.

One of the most experienced of NASA's space hands, having logged 566 hours of time in space, Cernan began his astronautic career in 1963. He participated in three space missions, including two flights to the Moon. As pilot of the Gemini 9 mission in June 1966, he became the second American to walk in space and he was lunar module pilot of Apollo 10 in 1969, a mission that was a dress rehearsal for the subsequent first Moon landing.

Cernan's opportunity to land on the Moon came in December 1972, when he commanded Apollo 17, the last scheduled manned mission to the Moon. Apollo 17 established several records, including: longest manned lunar landing flight, 301 hours and 51 minutes; longest lunar surface exploration, 22 hours and four minutes; largest lunar sample return, 249 pounds; and longest time in lunar orbit, 147 hours and 48 minutes.

In September 1973, Cernan was named special assistant to the Apollo Spacecraft Program manager. He assisted in the planning, development and evaluation of the Apollo Soyuz Test Project, the last manned space flight for the United States for some time to come. In 1975, Cernan became chief of training operations in the Astronaut Office.

Associate Administrator Mathews Retires

Mathews—"Mr. Gemini"

Charles W. Mathews, a 33-year veteran with NASA and its parent organization, NACA, announced his retirement at the end of February, adding that he planned to continue working at NASA headquarters at least through March to assure an orderly transition of managerial duties in the Office of Applications. Mathews has been Associate Administrator for Applications since that unit was established in 1971.

Administator James C. Fletcher said, "NASA recognizes the tremendous contributions made by Charles Mathews leading to our nation's preemience in space. Perhaps, more importantly, Mr. Mathews has provided strong leadership in applying what has been learned in space to practical uses here on Earth." Mathews' career in space and aeronautics began in 1942 when he joined the science staff at NACA's Langley Research Center. After NASA came into being in 1958, he served in the Manned Spacecraft Center (now the Johnson Space Center) as a specialist on Mercury spacecraft on the Project Mercury team. Mathews managed the Gemini program at JSC and, after its completion, became director of the Skylab program. In 1968, he was appointed Deputy Associate Administrator for Manned Space Flight, remaining in the post until his assignment to Applications.

Mathews received the NASA Distinguished Service Medal twice, in 1966 for his contributions to the U.S. manned space flight program and in 1969 for his contributions to the first manned lunar landing. NASA awarded him the Outstanding Leadership Medal in 1965. Mathews is a Fellow of the American Institute of Aeronautics and Astronautics.

California Field Station Is Revamped

New organizational and work functions were established in March for NASA personnel stationed at the contractor-operated Jet Propulsion Laboratory in Pasadena. NaPO, which formerly reported to the Associate Administrator for Center Operations, was replaced by two resident offices.

The reorganization established, first, a NASA Resident Legal Office-JPL, with John Warden as manager. He reports to the NASA General Counsel in Washington. The office will continue to handle general legal matters and patents and technology utilization.

The second new unit is the NASA Resident Procurement Office-JPL, with Allen Burke as manager. He will report to the NASA Assistant Administrator for Procurement. Management and operation of JPL by the Caltech will continue.

No loss of jobs or cuts in grade or salary for the 35 individuals employed at NaPO will result from the reorganization.

Two New Project Offices Open at Huntsville

A Spacelab Payload Project Office and a Special Projects Office have been established at the Marshall Space Flight Center, according to a recent announcement by director Dr. William R. Lucas. The first is headed by O. C. Jean, former deputy director of the Program Development Directorate, the second by Lowell K . Zoller, who was special assistant to Dr. Lucas.

The SPPO manages the development of Spacelab Payloads 1 and 2, which were assigned to the Alabama center recently by NASA's Office of Space Science. The SPO was established as a central organization for management of special projects that have advanced to the design and development stage and can be managed efficiently through the use of centralized common support services. At present, the office bears responsibility for management of the Laser Geodynamic Satellite Project, the Solar Heating and Cooling Project, and the Space Processing Applications Rocket Project.

Dr. Lucas also announced several personnel changes at the Marshall center. William R. Marshall has been reassigned as associate director for engineering, Science and Engineering Directorate. Formerly he was director of the Preliminary Design Office, Program Development Directorate.

James A. Downey III becomes deputy director of the Program Development Directorate, succeeding O.C. Jean. Downey was manager of the Space Telescope Task Team, as well as associate director for science in Program Development.

William C. Keathley has replaced Downey as manager of the STTT and Charles R. Darwin replaces William R. Marshall as director of the Preliminary Design Office.

Effort Underway to Popularize Solar Fuel Systems as Energy Savers

An agreement between NASA and the Energy Research and Development Administration has resulted in assistance by the Marshall Space Flight Center in the management of the Commercial Demonstration Projects portion of the National Solar Heating and Cooling Program. The goal of the demonstration project is to acquaint the nation's business and industrial community with the feasibility of using solar energy for heating, cooling and hot-water systems.

Special management responsibilities at the Alabama center include the evaluation of responses to Program Opportunity Notices, which are ERDA's equivalent of NASA's Requests for Proposals. In addition, MSFC is responsible for the administration and management of the demonstration projects resulting from awards made by ERDA.

Officials expect that between eight and twenty contracts will be awarded during 1976. So far 308 proposals have been received from industry in response to the notices issued.

ERDA Officials Are Briefed—Solar energy usage was the topic of conservation at the Marshall Space Flight Center recently, when officials of the Energy Research and Development Administration visited the NASA field installation. Briefing the ERDA group concerning cooperative NASA-ERDA programs is Don Bowden (left), manager of MSFC's Solar Heating and Cooling Project Office. At his right, are R. D. Scott, chief of ERDA's project branch for solar energy, and Dr. Henry Marvin, director of the division. Lowell K. Zoller, MSFC's chief of Special Projects office stands at far right.

D.C. Minority Businesses Are Briefed

NASA's Headquarters Minority Business Enterprise Council Subcommittee on Community Education sponsored the second in a series of meetings with minority business organizations recently. Its purpose was to inform Washington, D.C. business representatives of contracting opportunities available to them now and in the future at NASA's headquarters.

The seminar, chaired by Mrs. Ruth Bates Harris, Deputy Assistant Administrator of Public Affairs for Community and Human Relations, provided information about NASA's Minority Business Program on national and local levels. Program managers from the Office of Space Science and the Office of Aeronautics and Space Technology outlined the kinds of skills and abilities sought, and the types of programs carried out. Progress and goals during FY 1976 as they relate to minority businesses were discussed, as were contracts with 50 minority colleges.

The minority council sponsoring committee at NASA consists of Mrs. Harris; Lawrence W. Vogel, director of headquarters administration; Norman Draper, EEO management committee; and Earl L .Ginyard, headquarters EEO officer.

Forest Fire Alarm System

A new satellite-linked monitoring system recently began a continuous watch on thousands of square miles of precious California forests under an agreement between NASA's Ames Research Center and the California Division of Forestry. NASA's Technology Utilization program developed the ground-operated instruments in use.

The new assist from space to firefighters and fire control units is an inter-agency venture. First the NASA-developed automatic sensors measure wind and air factors, solar radiation, humidity and moisture content of material covering forest floors over a wide network ranging from the Oregon border to San Francisco Bay and from the Pacific Ocean inland to the coastal range of mountains.

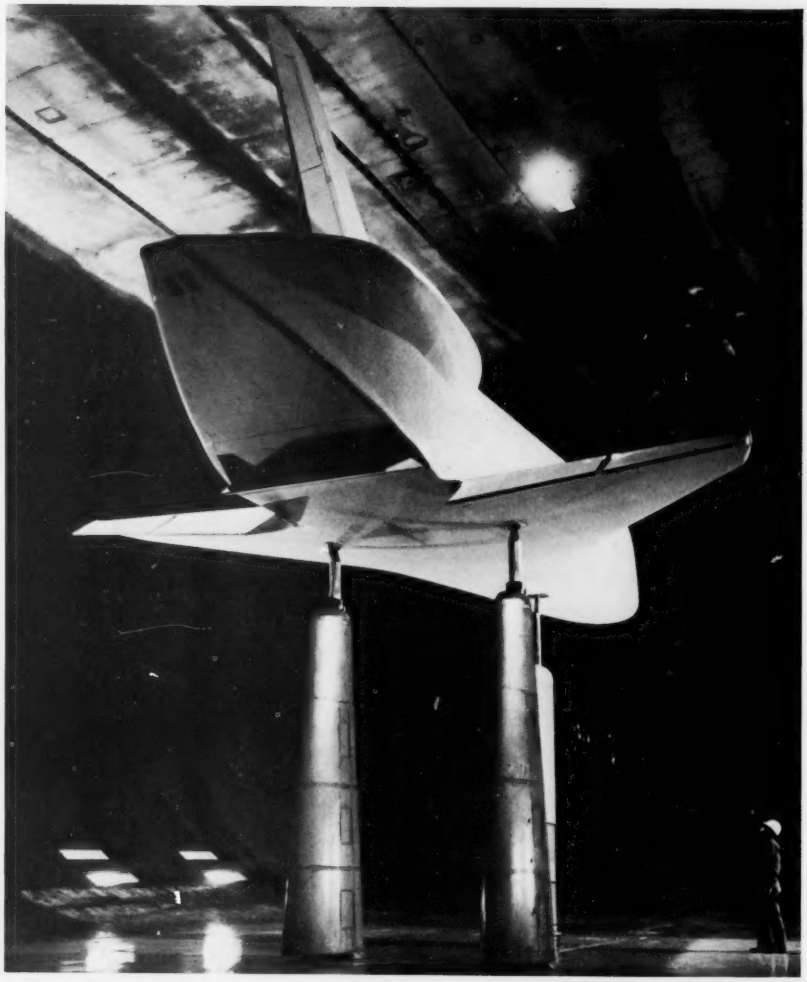
Acquired data are then relayed—once every three hours—through the NOAA-operated (National Oceanic and Atmospheric Administration) Synchronous Meteorological Satellite, pinpointed 25,000 miles above Earth, to a NOAA receiving station at Wallops Island, Va. NOAA computers process the data and forward them to the U.S. Geological Survey computer facility at Reston, Va., which in turn sends readouts to USGS offices in California. Ames personnel and the California Division of Forestry obtain the data from USGS facilities nearby. Processing and relay from start to finish is almost unbelievably rapid, taking 90 minutes or less.

Considered a potentially useful tool to help reduce annual losses from California forest fires, the system also may cut costs of fighting fires. Foresters use the continuously collected data to identify areas where fire hazards are greatest, deploy firefighting units to counteract threats, and plan fire-battling strategy.

Two prototype monitoring stations, designed and developed at Ames in cooperation with California forestry experts, were successfully tested for two years at Sunol and Mount Zion, Calif. The stations are expected to operate for a year without maintenance.

A Helping Hand for Smokey Bear—Batteries and electronics subsystems of automatic sensors that measure environmental factors in remote forest regions of California are inspected by William Innes (left) of the California Division of Forestry and Ken Nishioka, project engineer from the Ames Research Center. The monitoring system transmits information to satellites and faroff computer centers quickly, efficiently and at low cost, to measure threat and extent of potential forest fires. Three people can transport the 200-pound stations to remote regions and set them up in only an hour.

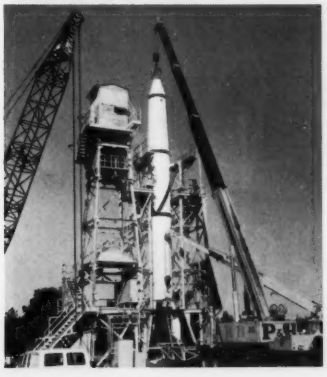
Legionnaires Favor NASA—Noah Smalley (middle) newly appointed chairman of the American Legion's Aerospace Committee—and a NASA employee at the Kennedy Space Center—called on Dr. James C. Fletcher recently to discuss possible assistance the veterans' organization might be able to extend to NASA. The committee considers all policy matters related to aerospace and recommends positions to be adopted by the Legion. The Legion, which has long advocated support of the space effort, passed a resolution at its 1974 convention in praise of NASA and giving ". . . highest recognition and wholehearted support to the men and women of NASA." Accompanying Smalley was James R. Wilson, Jr. (left), director of the National Security Division Staff of the Legion.



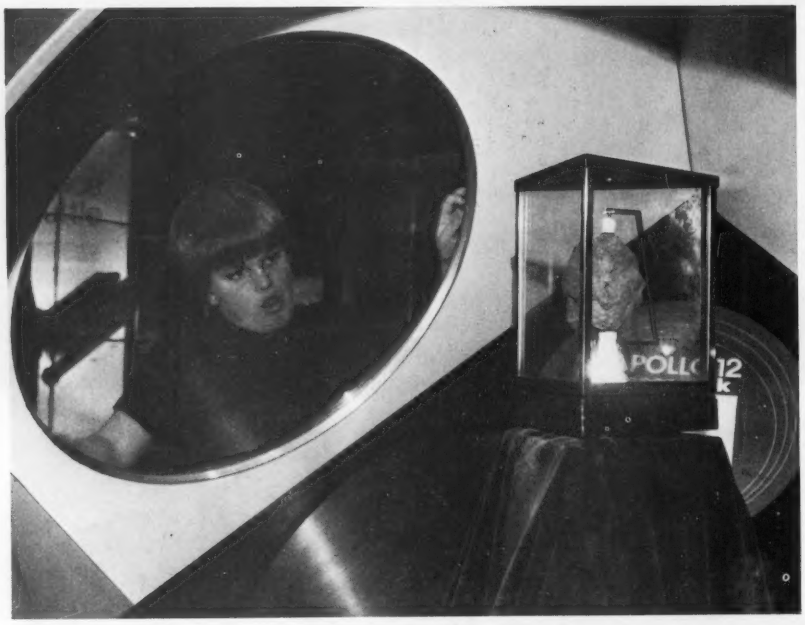
In a Windy Environment—A scale model one-third the size of the real Space Shuttle, complete with tail cone, will be tested repeatedly in the 40-by-80 foot wind tunnel at NASA's Ames Research Center. Horizontal test flights of the reusable space vehicle will begin in 1977. The Space Shuttle will undergo orbital test flights in 1979, and the complete spacecraft is expected to be operational in 1980.

Students Copy Energy Technology Operating at Lewis—Fifth-graders display an exact replica of the wind turbine built by NASA at the Lewis Research Center and operated by the Energy Research and Development Administration. Stephen Lehita (right) built the windmill in only 1½ months; John Kolencik (left) wrote the report on the school project. Teacher Jane Rusnak stands between the students, who attend the St. Vincent de Paul Elementary School at Cleveland. Stephen used his father's technical advice and a slim NASA brochure as instructional material for the 2½-foot-tall wooden model which duplicates the world's largest wind turbine, in operation for ERDA at Lewis' Plum Brook station at Sandusky, Ohio.

Astronauts Warmly Received in Mideast—Apollo astronauts Thomas P. Stafford, Vance D. Brand and Donald K. Slayton recently toured the Middle East under the sponsorship of the U.S. Information Agency. The group visited seven countries on the lecture tour, telling large and enthusiastic audiences about results of the Apollo-Soyuz mission, desert photography from space, and NASA's new program involving the Space Shuttle. The astronauts met with heads of state, scientists, and other high-ranking officials in Egypt, Saudi Arabia, United Arab Emirates, Qatar, Kuwait, Israel and Algeria. Seen in the accompanying photo are (left to right) Stafford, Brand and Slayton showing Skeikh Khalifa bin Hamad Al-Thani, Emir of Qatar, a photograph of his country taken from space. Dr. Farouk El-Baz of the Center for Earth and Planetary Studies, National Air and Space Museum, (far right) explains geological details.



Historic Rocket Test Stand Rejuvenated—A Redstone rocket test stand that played an important part in the early space program is getting a new Bicentennial look in preparation for the many tourists expected at the Marshall Space Flight Center on public bus tours in 1976. The test stand, neglected since the final test firing in October 1961, has been cleaned up and a Redstone rocket belonging to the U.S. Army Missile Command has been installed on it. During its active period—1953 to 1961—the Redstone rocket was the mainstay for 364 test firings. These included the Jupiter-C, which launched America's first satellite, and the Mercury-Redstone series, which placed the first Americans in space.



A Precious Piece of Rock—The second largest piece of the Moon on display anywhere on Earth recently was installed in the lobby of the Alabama Space and Rocket Center at Huntsville. NASA's Marshall Space Flight Center uses the lobby as its visitor information center. The moon stone, collected from the lunar surface by the crew of Apollo 12 in 1969, weighs 449 grams (15.7 ounces), outweighed only by the moon rock on display at the Smithsonian Institution in Washington, D.C. (478.8 grams or a little more than a pound). Gary Howell, a visitor from Jackson, Ala., looks at the sample.

President Ford Praises Lewis Group—Six Lewis Research Center employees display Presidential letters commending them for contributions to substantial economies and improvements in government operations. Savings represented by suggestions made by the six individuals amounted to $73,023 to NASA. Lewis deputy director Dr. Bernard Lubarsky made the presentations. Standing left to right in photograph are: Everett C. Armentrout, Alan C. Duncan, Dr. Julian M. Earls (Chairman, Incentive Awards Committee), Dr. Lubarsky, James H. Hurst and Robert W. Robinson. Seated are William J. Kundtz (left) and Danny Rusyniak.

King-sized Savings at Marshall—Fred Jankowski (left), an engineer in the Structures and Propulsion Laboratory at NASA's Marshall Space Flight Center, receives a Presidential Letter of Commendation for a suggestion that resulted in a $50,000 saving to the agency. Dr. William R. Lucas, MSFC director, presented the framed letter at a special ceremony in mid-March. The letter award is part of the President's special campaign for cost reduction within the Federal government. Six other Marshall employees have received similar recognition for suggestions that resulted in savings of $5,000 or more for each one.

New Appointment at Dryden Center

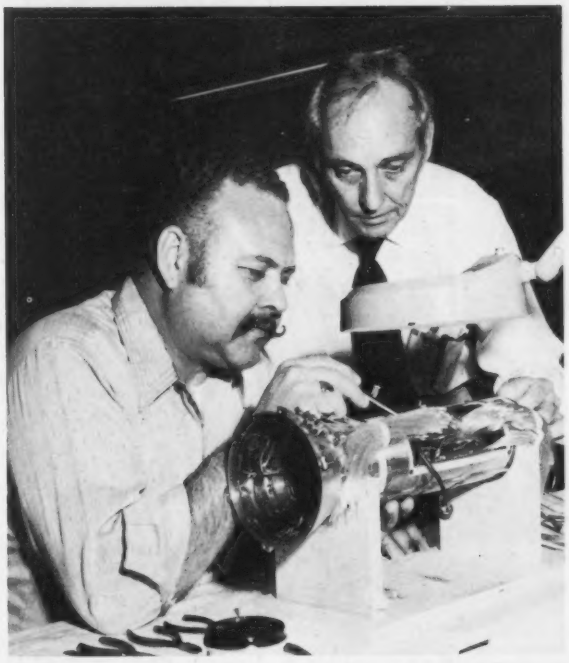
Gerald D. Griffin, a deputy associate administrator in the Office of Space Flight, became deputy director of the Dryden Flight Research Center on May 1. The DFRC, NASA's prime center for aeronautical flight research, is the site for initial atmospheric flight tests of the Space Shuttle Orbiter to take place next year and the site for Orbiter landing and recovery during the first few orbital flight tests in 1979.

Griffin has served in NASA headquarters since early 1973, after having been flight director for the first 11 Apollo missions and lead flight director for Apollos 12, 15 and 17, at the Johnson Space Center.

A native of Athens, Tex., Griffin joined NASA in 1964, and served until 1968 as a flight controller in Mission Control during the Gemini program before assuming his Apollo flight director duties.

Griffin received a B.S. in aeronautical engineering at Texas A&M University, served for four years in the U.S. Air Force, and was an aerospace engineer with the Lockheed Missile and Space Co. and with General Dynamics before joining NASA.

Griffin has received numerous awards including two NASA Exceptional Service medals for his work on Apollo 12 and 15, the Presidential Medal of Freedom Group Achievement Award for Apollo 13 and, most recently, the NASA Headquarters Creative Management Award while serving as Assistant Administrator for Legislative Affairs.



Miniature Solid Rocket Booster—Marshall Space Flight Center technicians Carl T. Walker (left) and James M. Willis at work on a 7/250-scale model of the Solid Rocket Booster for testing in the Ames Research Center large wind tunnel. Designed by Herschel W. Belew of Marshall's Systems Dynamic laboratory, the model will contain electronic sensors at 350 locations to provide data on pressure distribution, stability characteristics and nozzle load.

Fiftieth Rocket Anniversary Celebrated

The historic flight of the first liquid-fueled rocket by Dr. Robert H. Goddard—generally regarded as the beginning of modern rocketry and space flight—took place on March 16, 1926. The event was re-enacted at NASA's Goddard Space Flight Center (Greenbelt, Md.) on the anniversary date in 1976, with a solid-fuel motor substituted.

Considered as crucial to space flight as the first aircraft flight by the Wright Brothers was to aeronautics, Dr. Goddard's rocket reached an altitude of 12½ meters (41 feet), traveled 57 m. (184 ft.), falling to Earth 2½ seconds after liftoff after attaining a speed of 97 kilometers per hour (60 m.p.h.).

Historic Firing Recreated—Spectators braved cold rain and watched from windows at the Goddard Space Flight Center as a replica of Dr. Robert H. Goddard's first liquid-fueled rocket was fired last March 16 at GSFC. Special noon ceremonies marked the 50th anniversary of the firing near Auburn, Mass. and the 15th anniversary of the center.

Blazing New Trails for Indian Students

Three Indian engineering students at the University of Oklahoma have been awarded $2,500 scholarships and summer jobs at NASA's Johnson Space Center under the NASA Aerospace Fellowship Program. The intern program also will provide $1,000 to the College of Engineering for administrative support. The NASA internship is part of the Federal Summer Intern Program.

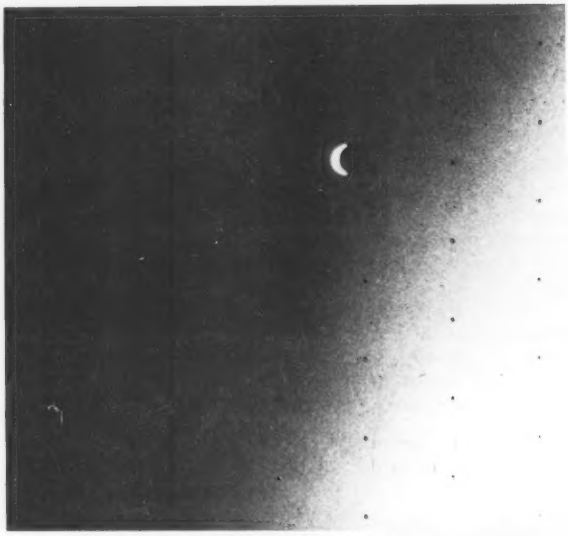
The selected students are Greg Tracy, a sophomore in chemical engineering; Karen Johnson, a junior in computer science engineering; and Margaret Wilson, a sophomore in electrical engineering.

Two officials of the NASA program met with Oklahoma University's President Paul F. Sharp and dean of the College of Engineering William R. Upthegrove recently to finalize plans for implementing the program. After their meeting, Jurgen Pohley of the NASA headquarters Office of University Affairs, said: "The University of Oklahoma College of Engineering came to our attention because of its good engineering reputation and because of its sound program for fostering the advancement of the Indian students. The program's objective is to encourage minorities and women to undertake professional careers in engineering and science to become NASA employees."

The selected students will work with other engineers at jobs that fit their career areas, according to George Thomas, director of Indian programs in the University's College of Engineering. "The program gives the students valuable experience in working in industry and will provide considerable financial support," Thomas said. "Any student who has had practical experience also can command higher starting salaries once he has been graduated."

NASA Fellowships to American Indians—Representatives of NASA and the University of Oklahoma discuss the NASA Aerospace Fellowship Program, which chose three American Indian engineering students for internships at JSC, to begin in June. A meeting at the university's main campus in Norman included (l. to r.) Engineering College dean William R. Upthegrove; JSC engineer Jerry Elliott (active in the center's programs aimed at understanding native American cultures); Oklahoma University President Paul F. Sharp; NASA's Jurgen Pohley; and George Thomas, director of Indian Programs at the College of Engineering.

Conventioneers in a Happy Mood—An address by NASA's Ruth Bates Harris, holding microphone, was a well-received feature at a luau for participants at a Federally Employed Women's semiannual convention held recently in Cocoa Beach, Fla. Mae Walterhouse, national first vice president of FEW and Federal Women's Program Coordinator at the Kennedy Space Center, is at left; Lynn Herbert, president of the Surfside Chapter, FEW, and a secretary in the Air Force Shuttle Liaison Office at KSC, is at right. Harris later visited Florida again to participate in KSC's Black History Week activities.



Unearthly View—A raw photograph of Earth from more than 7 million miles in space was taken by Mars-bound Viking 2 about a month after launching in autumn of 1975. The eastern Pacific is in the crescent-shaped illuminated section, the west coast of North America on the right side of the brightly lit curve. The illumination is caused by the camera system and the pattern of black dots is on the faceplate of the camera, for geometric calibration of the pictures. Viking 2 will send its Lander to the surface of Mars in early September 1976; Viking 1 reaches Mars earlier, on July 4.

NASA Film Announcements

"Life?" and "Mars—Is There Life?", two 15-minute films of a three-part series, were released in January and March. The series highlights the Viking life-detection experiments and discusses possible past history and present topography of Mars. Emphasis is placed on the Viking biology and chemistry experiments in relation to the search for life on Mars.

Radio-Television

(*Released nationally*)

RADIO: Four weekly *Space Story* programs have been released—"Langley "Tech House" (LaRC/Samos); Martian Life Search: Viking" (Caltech/Horowitz); "Truck Aerodynamic Research" (FRC/Steers); "Viking Water Vapor Mapping" (JPL/Farmer). One monthly *NASA Special Report* has been released: "A Biologist's Viewpoint: The Search for Life on Mars" (Dr. Lynn Margulis, Boston U.).
TELEVISION: Two color films have been released in the *Aeronautics and Space Report* monthly film series: "Vikings Speed toward Mars," and "Computer Graphics" (ARC). Each one is in two versions—4½ minutes and 90 seconds.

Lunar Sample Exhibits

The following is a schedule of lunar sample exhibits from April 15 to May 15, 1976:

ALABAMA—Bicentennial Armed Forces Day Open House, Anniston, May 15.

CALIFORNIA—Gemstone Festival, Sacramento, May 15-16.

INDIANA—Spacemobile Program at Museum of Arts and Science, Evansville, April 26-31.

OHIO—Armstrong Air and Space Museum, Wapakoneta, April 1-Sept. 1.

MASSACHUSETTS—Dighton Rock Museum, Dighton, May 9.

MISSOURI—Joplin Bicentennial Airshow, Joplin, May 8-9.

TEXAS—Third Annual Heritage Festival and Bicentennial Celebration, April 21-25; Scout-O-Rama, Texarkana, April 27-May 18.

AMERICAN FREEDOM TRAIN—Memphis, Tenn., April 20; Jackson, Miss., April 27; New Orleans, La., May 4: Birmingham, Ala., May 14.

HIGH FLIGHT FOUNDATION BICENTENNIAL MOBILE SPACE MUSEUM—LaCrosse, Wis., April 13-18; Duluth, Minn., April 20-25; Waterloo, Iowa, April 27-May 2; Watertown, S.C., May 4-9; Tulsa, Okla., May 10-16.

TENNESSEE VALLEY ASSOCIATION-BICENTENNIAL CARAVAN—In North Carolina: Washington, April 16; Plymouth, April 17; Rocky Mount (and/or Wilson), April 18-20; Oxford, April 21; Raleigh, April 22-23; Greensboro, April 24; High Point, April 25-26; Winston-Salem, April 27; N. Wilkesboro, April 28. In Virginia: Gate City, April 30-May 1; Jonesville, May 2-4; Big Stone Gap, May 5-6; Norton, May 7; Coeburn, May 8. In Kentucky: Hazard, May 9-10; Prestonburg, May 11; Ashland, May 12-13; Morehead, May 14; Richmond, May 15.

Long Term Displays

ALABAMA—Alabama Space and Rocket Center, Marshall Space Flight Center, Huntsville.

FLORIDA—Visitor Information Center, Kennedy Space Center.

KANSAS—Eisenhower Library, 200 S.E. 4th St., Abilene.

MISSISSIPPI—The National Space Technology Laboratories, Bay St. Louis.

NEW YORK—United Nations Building, New York City.

OHIO—USAF Museum, Wright Patterson AFB.

TEXAS—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston.

VIRGINIA—Visitor Information Center, Langley Research Center, Hampton.

WASHINGTON, D.C.—National Geographic Museum; Smithsonian Institution, National Air and Space Museum, 1000 Jefferson Drive; Washington National Cathedral.

Projected Launch Schedule

(As of May 1976)

Name	Launch Date	Vehicle	Range	Mission Remarks
Comstar-A	May 6	Atlas/Centaur	ETR	Second domestic communications satellite for Comsat. Reimbursable.
Air Force Test	May 21	Scout	WTR	USAF scientific payload. Reimbursable.
Marisat-B	May 27	Delta	ETR	Third Comsat satellite to provide maritime satellite communications service. Reimbursable.
Relativity	June	Scout	Wallops	Scientific probe to make a test of the Einstein Theory.
Navy Transit	June 23	Scout	WTR	Navy Navigation satellite. Reimbursable.
Indonesia-A (Palapa)	July	Delta	ETR	Indonesian communications satellite. Reimbursable.
NATO IIIB	August	Delta	ETR	Communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable.
Comstar-B	August	Atlas/Centaur	ETR	Second domestic communications satellite for Comsat. Reimbursable.
ITOS-E2	September	Delta	ETR	Operational meteorological satellite of the National Weather Service to provide day and night cloud-cover imagery. Reimbursable.
RCA-C	October	Delta	ETR	Third domestic communications satellite for RCA. Reimbursable.
Marisat-C	December	Delta	ETR	Third Comsat satellite to provide maritime satellite communications service. Reimbursable.
Intelsat-IVA-C	December	Atlas/Centaur	ETR	Third of a series of improved Intelsat satellites. Reimbursable.

NASA Tech Briefs

The Technology Utilization Office, NASA Headquarters

(The following is a listing of published NASA Tech Briefs. Inquiries concerning them should be directed to the TU office of the originating NASA center.)

Innovator(s)	Title	Number	Center
L. A. Hein and W. N. Myers, MSFC	Mechanical Solar Motor: A Concept	B74-10292	MSFC
John Dimeff, ARC	Regulator for Intravenous Feeding	B75-10083	ARC
R. C. Hendricks, I. C. Peller and A. K. Baron, LeRC	Computer Program for Calculating Water and Steam Properties	B75-10187	LeRC
F. F. Simon, LeRC	Comparative Performance of Twenty-three Types of Flat Plate Solar Energy Collectors	B75-10189	LeRC
James Sucec, LeRC	Calculation Procedure for Transient Heat Transfer to a Cooled Plate in a Heated Stream Whose Temperature Varies Arbitrarily with Time	B75-10244	LeRC
George E. Glawe, LeRC	A New High Temperature Noble Metal Thermocouple Pairing	B75-10245	LeRC
F. D. Lemkey, United Technologies Corp. Research Labs, LeRC	Superior High Temperature Properties Available in Directionally Solidified Nickel-Base Eutectic Alloys	B75-10246	LeRC
A. F. Forestieri, T. M. Klucher, C. J. Adlard and R. K. Shaltens, LeRC	Inexpensive Pocket-Sized Solar Energy Meter (Insolometer)	B75-10283	LeRC
Jerry D. Christian and William P. Gilbreath, ARC	Apparatus for Study of Plasmas at Elevated Temperatures	B75-10285	ARC
M. T. Moore and E. B. Smith, General Electric Co. LeRC	Sound Separation Probe	B75-10286	LeRC
	Turbine Design Review Text	B75-10287	LeRC
T. Spalvins and W. A. Brainard, LeRC	Induction Heating Simplifies Metal Evaporation for Ion Plating	B75-10288	LeRC
A. F. Forestieri, A. F. Ratajczak and L. G. Sidorak, LeRC	Solar Power Roof Shingle	B75-10289	LeRC
C. H. Liebert and S. Stecura, LeRC	Ceramic Thermal Protective Coating Withstands Hostile Environment of Rotating Turbine Blades	B75-10290	LeRC
James R. Rogers, ARC	Improved Aircraft Reaction Nozzles	B75-10284	ARC

Carroll T. Pardoe of Johns Hopkins University	Delay-Lock-Loop Code-Correlation Synchronizer	B75-10291	GSFC
Adelaide Del Frate, GSFC	Computer System for Library Access	B75-10292	GSFC
Ting L. Chu of Southern Methodist University	Low-Cost Thin-Layer Silicon Solar Cells	B75-10293	GSFC
Barton J. Howell, GSFC	General Optics Evaluation Program (GENOPTICS)	B75-10294	GSFC
J. G. Moik of Computer Science Corp.	Small Interactive Image Processing System	B75-10295	GSFC
Larry D. Holley, KSC	Monitor for Checking Electric-Field Meters	B75-10296	KSC
Carl L. Lennon, KSC	Time-of-Arrival Lightning Activity Location System	B75-10297	KSC
Jan Roskam of University of Kansas	Static Aeroelastic Program	B75-10298	LaRC
Vincent M. Cannuli of RCA Corp.	Formation of Internally-Confined Semiconductor Lasers	B75-10299	LaRC
Vernon L. Alley, Jr., and Austin D. McHatton, LaRC	Amplifying Ribbon Extensometer	B75-10300	LaRC
E. P. Herndon and K. G. Anthony, MSFC	Low-Cost Hot-Air Solar Collector	B75-10301	MSFC
Project Schedules and Analysis Group, LaRC	The Langley Research Center NASA/PERT TIME III	B75-10302	LaRC
Robert M. Baucom, Harry E. Johns and Robert C. Evans	Lightweight Orthotic Braces	B75-10303	LaR C
D. P. Nicolas, MSFC	Microcircuit Testing and Fabrication, Using Scanning Electron Microscopes	B75-10304	MSFC
R. A. Gange of RCA Corp.	Read-Only Optical Storage Medium	B75-10305	MSFC
J. E. Dengenford, L. E. Dickens, D. W. Maki, and B. A. Newman of Westinghouse Electric Corp.	Temperature-Stable Gunn-Diode Oscillator	B75-10306	MSFC
S. Levinson of United Aircraft Corp.	Signal Mixer for Optical Heterodyne Receiver	B75-10307	MSFC
F. G. Allen, A. S. Yue, and J. G. Yu of University of California	Contact-Eutectic-Lens Fabrications Technique	B75-10308	MSFC
W. P. Coppfer of Martin Marietta Corp.	Foam-Machining Tool with Eddy-Current Transducer	B75-10309	MSFC
J. G. Austin, J. W. Bransford, and C. F. Key	Flammability Study of Materials in Oxygen Environments	B75-10310	MSFC
H. A. Wright, P. J. Remington, and R. Madden of Bolt Beranek and Newman, Inc.	The Impact of Water on Free-Falling Bodies	B75-10311	MSFC
R. A. Thiel and G. D. Schmidt of General Dynamics Corp.	Quality Control of Microelectronic Wire Bonds	B75-10312	MSFC
H. B. McKee of McDonnell Douglas Corp.	Compound Heat Pipe Operates Over Broad Temperature Range	B75-10313	MSFC
A. P. Sanders, R. J. Williams, W. R. Downs, and H. McBryar	Using Permeable Membranes to Produce Hydrogen and Oxygen from Water	B75-10314	JSC
J. L. Horner of Dept. of Transportation	Optical-Noise Suppression Unit: A Concept	B75-10315	JSC
L. G. Monford, Jr.	Solid-State Motor Control and Monitor System	B75-10316	JSC
K. A. Buckle, T. P. Labuza and H. C. Wermbier of the University of Minnesota	Control of Nonenzymatic Browning to Intermediate-Moisture Foods	B75-10317	JSC
F. L. McWhorter and D. E. Cartier, The Magnavox Co.	Power Spectrum Analysis of Staggered Quadriphase-Shift-Keyed Signals	B75-10318	JSC
E. T. Hansard of General Dynamics Corp.	Biaxial Compression Test Technique	B75-10319	JSC
D. W. Karle, R. H. Kratze, and K. L. Pacioren of Ultrasystems, Inc.	A Flame-Resistant Modified Polystyrene	B75-10320	JSC
D. Mui of Rockwell Intl. Corp.	Repair of Damaged Insulation Tiles	B75-10321	JSC
G. E. Meunier of Rockwell Intl. Corp.	Fast Semiautomatic Dimensional Test Set and Data Logger	B75-10322	JSC
Tage O. Anderson of Caltech/JPL	Multichannel High-Speed Correlator	B75-10323	NaPO
Cristopher England of Caltech/JPL	Acid/Alkali Bromide Secondary Battery	B75-10324	NaPO
Tage O. Anderson, Jack K. Holmes, and William J. Hurd of Caltech/JPL	Synchronizer for Random Binary Data	B75-10325	NaPO
Tage O. Anderson of Caltech/JPL	Computer/Computer Interface	B75-10326	NaPO
Alan Rembaum of Caltech/JPL	Covalent Bonding of Polycations to Small Polymeric Particles	B75-10327	NaPO

Charles E. Griffin of Caltech/JPL	Electro-Optical Detector to Improve Sensitivity of a Focal-Plan Mass Spectrometer	B75-10328	NaPO
F. J. Grunthaner of Caltech/JPL	Collimation of Electron and X-Ray Beams Using Zeolite Crystals	B75-10329	NaPO
Kenneth A. Green of Microwave Research Corp.	Highly Efficient Horn/Reflector Antenna	B75-10330	NaPO
Heinz G. Boettger, Charles E. Griffin, William J. Dreyer, and Aron Kuppermann of Caltech/JPL	Automated Mass Spectrometer/Analysis System: A Concept	B75-10331	NaPO
Alain L. Fymat of Caltech/JPL	Developments in Spectrophotometry I: An Instrument for High-Resolution Measurements of Optical Intensity and Polarization	B75-10332	NaPO
Alain L. Fymat of Caltech/JPL	Developments in Spectrophotometry II: A Multiple-Frequency Particle-Size Spectrometer	B75-10333	NaPO
Walter H. Higa of Caltech/JPL	Simplified Heat Engine	B75-10334	NaPO
Alain L. Fymat of Caltech/JPL	Developments in Spectrophotometry III: Multiple-Field-of-View Spectrometer to Determine Particle-Size Distribution and Refractive Index	B75-10335	NaPO
William A. Mueller, George C. Hsu, and Harold E. Marsh of Caltech/JPL	New Urea-Absorbing Polymers for Artificial Kidney Machines	B75-10336	NaPO
Satoshi Nagano of Caltech/JPL	Trigger Circuit Forces Immediate Synchronization of Free-Running Oscillator	B75-10337	NaPO
Alain L. Fymat of Caltech/JPL	Minimization Search Method for Data Inversion	B75-10338	NaPO
H. McBryar, JSC	Reconstituted Asbestos Matrix for Fuel Cells	B75-10339	JSC

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.

Inventor(s) and Employer(s)	Title and NASA Docket	Patent No.	Installation
William G. Simpson, NASA/MSFC	Mixing Insert for Foam Dispensing Apparatus	3,941,335	MSFC
Allan R. McDougal, Caltech/JPL Robert M. Norman, Pasadena, Calif.	Zero Torque Gear Head Wrench	3,942,398	NaPO
John Dimeff, NASA/ARC	Method and Apparatus for Compensating Reflection Losses in a Path Length Modulated Absorption-Absorption Trace Gas	3,943,368	ARC
Howell D. Garner, NASA/LaRC	Magnetic Heading Reference	3,943,763	LaRC
Joseph Maserjian, Caltech/JPL	Method and Apparatus for Measurement of Trap Density and Energy Distribution in Dielectric Films	3,943,442	NaPO
Charles G. Miller, Ralph E. Bartera, Caltech/JPL	Continuous HCL in Air Indicator	3,945,801	NaPO
Cyrus C. Haynie, Samuel V. Messineo, North American Rockwell, Downey, Calif.	Apparatus for Positioning Modular Components on a Vertical or Overhead Surface	3,945,879	LaRC

Are you getting your **1 cent** worth from **NASA**?

For a penny of your tax dollar,
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Rapid and Inexpensive Mapping of Water Resources

Countries that have no inventory of their water resources can obtain accurate maps of their lakes and reservoirs from satellite data at relatively small cost by using a new NASA computer program.

State agencies can use the program to make efficient choices between use of available water supplies for recreation or for industry.

The computer program, developed at NASA's Johnson Space Center, uses digital data from Landsat earth resources survey satellites to compile maps at any desired scale, showing surface water areas in excess of six acres.

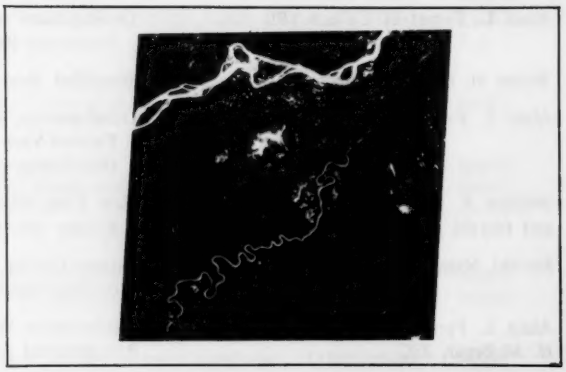
Specialists in the Earth Observations Division at JSC say the new system, called the Detection and Mapping Package, is so simple that only $300 worth of computer time is needed to map more than 33,800 square kilometers (13,000 square miles).

A country such as Paraguay, for instance, could obtain high quality surface water maps of the entire country (408,200 sq. km., or 157,000 sq. mi.) for less than $10,000, including all computer and labor costs.

NASA's two Landsats cover about 95 percent of Earth's land mass, therefore maps of surface water can be produced under the system for virtually all populated regions. Accuracy of the program is almost 100 percent for areas of water measuring 4 hectares (10 acres) or larger. Position accuracy—the degree to which the computer-produced water maps match the terrain in question—is within 90 meters (300 feet) of dead center.

The scientists who developed the system explain that user training is extremely brief, typically as short as one day, and no computer or remote sensing experts are needed to implement the water-mapping program.

The Army Corps of Engineers used the satellite-computer package to map water resources in Washington and Tennessee. The Texas Water Development Board has used the program for regional water mapping in Texas and regional agencies in Oklahoma also have used the program.



This Landsat photo of the Amazon and Purus Rivers in the heart of the Brazilian jungles emphasizes the ability of satellite sensors to discriminate between water of varying quality because of sediment. Reflected energy is indicated by the light regions, (top and middle) which means that the river water is highly silty. Lakes in the area are clearer, therefore do not reflect as much light. The Trans-Amazon highway is seen in lower right side of picture.

A Landsat view of Arctic regions (the Cornwallis-Devon Islands) shows ice conditions offshore. The satellite's capability has been likened to putting the whole Earth under a microscope.

NASA

National Aeronautics and
Space Administration

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AMERICAN REVOLUTION BICENTENNIAL 1776-1976